TONGUE-ROOT AND REGISTER IN MON-KHMER[1]

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1. *Aspects of Mon-Khmer Register*

Characteristic of many Mon-Khmer languages is the tendency towards complexity of vocalics often i association with what has come to be called *voice register*. This term was first used by Eugénie J. A Henderson (1952) to describe contrastive syllables Cambodian. These two registers with their associat features may be summarized as follows.

	Initial (written) Consonant	*Voice Quality*	*Vowel Quality*	*Pitch*
First Register	(original) surds	normal head clear tense	more open, onglided	relativ higher
Second Register	(original) sonants	deep breathy sepul- chral chest relaxed	close, centering diphthongs	relativ lower (larynx also lowered

Chart 1

The two series described here, that is the cor relation set of the Indic-derived consonantal symbo associated with various vocalic phenomena, had earl been observed by Haswell (1901), Blagden (1910), an Halliday (1922) for Mon, and by G. Maspero (1915) f Khmer (Cambodian). Blagden noted that in Mon the nd series (associated with written sonants) is er 'guttural' and is 'articulated from the rear he mouth'. He cites J. M. Haswell's earlier rvations that the second series was also proced in a 'softer' fashion. Halliday also reized the existence of this basic division in Mon ology, adding that the voiced initial series is owed by a vowel with a 'deeper tone'. Maspero d the previously described series features in and confirmed that a substantially parallel ation was true for Khmer.

More recently, Shorto (1966:399, 400) has said for modern spoken Mon:

e paratonal register distinction is broadly simar to that described for Cambodian by Henderson. s exponents are distributed throughout the arculatory complex but exclude pitch features. est register, symbolized by a grave accent placed er the vowel (kèt, hakòa), is characterized by eathy voice quality in association with a neral laxness of the speech organs and a *elatively centralized articulation of vowels.* e more frequent head register is unmarked in e transcription (ket, hakoa); it is characterzed by a clear voice quality, relative tenseness, d peripheral vowel articulation.

er introductory text on Cambodian, Jacob (1968:4) s the following description of register phenoa:

ere is potentially a distinction of voice quality the utterance of the vowels and diphthongs of e two registers, those of the first register ing pronounced with a clear, 'head' voice and certain degree of tension and those of the cond with a breathy, 'chest' voice and a mparatively relaxed utterance. This difference voice quality will, however, not be heard in e speech of all speakers.

The term 'pharyngealization' has also been applied to register articulation. Noss (1966:92ff) says of Cambodian:

> In Standard and Phnom Penh, all complex vowel nuclei (*i.e.* clusters and long vowels) which begin with a non-low vowel phoneme and remain at that level or fall lower, are, facultatively and non-distinctively, pharyngealized. (In the writing system this distinction is represente almost perfectly insofar as Standard is concerned by the selection of initial consonants.)

This apparently refers to the set called second register (or series) elsewhere. Pharyngealization in an apparently different sense, however, appears what Noss describes as a 'voiced pharyngeal spirant /H/ plus rising pitch' as the normal reflex of /r/ in Phnom Penh speech.

Jenner (1966:19ff) has surveyed some of the features manifesting register not only in Mon, and Khmer proper, but on a wider scale, including other lesser known Mon-Khmer languages of Southeast Asia. In *commentary form, taking features attributed to* register in these other languages, he draws comparisons or contrasts with articulations in Khmer. Here I summarize only the references to Khmer register phenomena. With reference to *movement of speech organs*, he says (1966:32):

> The essential movements occurring in Khmer may be said to be (a) a lowering of the larynx and (b) a widening of the faucal pillars, both contributing to the distention of the pharyngeal cavity. I suspect that a third movement is involved, namely a narrowing of the isthmus faucium by backing the radix of the tongue toward the pharyngeal wall.

As for the *locus of resonance* (33), 'the effect of this complex action ...is to emphasize the role he pharynx as a resonator'. On the question of *tense-lax distinction* he says (34), 'vowels with resonance are typically lax while those with ryngeal resonance are preponderantly tense. Such eness is presumably referable to the act of ending the pharyngeal chamber'. One notes in ing here that Jacob attributes tenseness and ess to the opposite registers from Jenner and Shorto's use of these terms for Mon parallels of Jacob for Cambodian. Turning now to *pitch*, er comments (35):

> atever its historical rationale, pitch in modern mer appears to be an effect of the muscular nsion already noted and a by-product of the sential actions involved in pharyngealization. e pitch of vowels uttered with oral resonance normal, there occurring no articulatory activi-es to modify it: The pitch of vowels with aryngeal resonance is low in relation to normal--ich is tantamount to saying that during pharyn-ealization the frequency of vibrations of the cal cords is retarded. This lowered frequency accounted for partly, perhaps, by the general nseness of the laryngeal zone and partly by a version of muscular effort to the lowering of e larynx. Normal and low pitch are relative, e interval between the two being three or ur semitones.

lly, on *openness of the oral cavity* this ex-ation (36) is offered:

> Khmer, syllable nuclei that preserve oral sonance are articulated with the tongue in a wer position than their counterparts that have veloped pharyngeal resonance. This is not the me as saying that pharyngealization has entailed raising of the tongue above its normal level, r generally it has been the Low Series nuclei at have suffered the greatest change. This wering of the oral nuclei, while possibly tributable to the greater laxness which character-es the Low Register, more probably reflects an ge (which pitch alone was unable to satisfy) to

> reinforce the contrast between the oral and the pharyngealized nuclei. In order to see the general nature of this tongue lowering it is useful to view the two series of nuclei ... from the point of view of their development out of a former single set, represented ... with sufficient accuracy by their common Indic transliteration ... the nuclei ... of the High Register show less development away from their supposed prototypes than those of the Low Registe It can be seen that the urge toward a lowered tongue postion in the Low Register has been ful- filled in two ways: (1) by the development of a low onglide before some oral vowels and (2) by a more or less perceptible lowering of the tongue with other oral vowels. When this lowering has been marked the change has resulted in functional contrast; when it has been less marked the change is merely phonetic.

In 1962 Phillips demonstrated that certain Mon Khmer languages in Vietnam (specifically Mnong Bunc Hre, and Sedang) also possess register systems similar to those described for Cambodian and Mon. Further recent work on highland languages of Vietna and Laos has revealed that the register phenomenon in varying forms has a fairly widespread distributi within the Katuic and North Bahnaric branches of Mc Khmer (Miller 1967, Cooper 1965, Gradin 1965). Historical reconstruction has established register as an original feature of North Bahnaric and perhap Bahnaric as a whole (Smith 1972). Register charac teristics of some of these languages are summarized in Chart 2.

While it is evident enough from the above dis- cussion that many Mon-Khmer languages exhibit a basic phonological bifurcation and that the two classes have been labeled as contrastive, the traditional labels have often tended to be on the impressionistic side. This is not altogether sur- prising for, as a matter of fact, in a number

Register features in Mon-Khmer languages of Vietnam

guage	*First Register*	*Second Register*
ng Bunor	tight,	loose,
	lower vowel,	higher vowel,
	fortis initial stops (vl. and imploded)	lenis intial stops (voiced)
	vocal cords tense,	vocal cords relaxed
	faucalization,	deep, muffled,
	clear, bright,	breathy,
	'natural',	(abnormal),
	lower vowel (if different)	higher vowel (if different)
ang	tight,	looser, deeper (but not as deep as in Hre),
	pharyngealized (rasp),	not pharyngealized,
	weak glottal stop preceding pharyngealization	'natural'
	clear quality	deep quality,
		relaxed faucal pillars,
		lowered larynx,
		increased diaphragm pressure,
		lower pitch,
		higher vowel
ang	shrill,	breathy,
	clear	having undertones,
		dark sounding

Register features in Mon-Khmer languages in Vietnam

Language	*First Register*	*Second Register*
Rengao	sharply defined,	'deep' pharyngea resonance,
	oral (clear) resonance,	
	pharyngeal cavity constricted,	pharyngeal cavit expanded,
	larynx normal to high,	larynx lowered,
	tongue root retracted,	tongue root advanced,
	tongue blade lowered	tongue blade raised
Brou	tense,	relaxed,
	slightly faucalized,	deep, muffled,
	lower vowel	higher vowel
Pacoh	pharyngealized,	normal
	faucalized,	
	tense	

Chart 2

he languages in question, the impressions created
registral features are indeed dramatic. And
tainly from a phonemic point of view, any set of
ns may serve to designate that A ≠ B. However,
descriptions of register phenomena cited in the
ks above have also referred to clearly articula-
features of the question.[2] Taking this orienta-
n towards the more concrete aspects of register as
ue, I should like to suggest that such endeavors
be more specific about the articulatory basis for
-Khmer register yield further insight into tradi-
nal problems in these languages (and perhaps even
ond)--specifically, that a clarification of the
ure of articulation in the pharyngeal region pro-
es the unifying basis for the features associated
n Mon-Khmer register.

Tongue-Root Articulation and Register Effects

Vocalic Openness

In an article on Akan, a West African language,
I. Stewart (1967) has fixed on the tongue-root as
rimary articulator and its positioning as the basis
contrast between the two sets of vowels that
tion in the vowel harmony characteristic of that
guistic area.[3] The point of great interest in
approach by Stewart is that the tongue-root
tioning correlates with vowel openness. That is,
tongue-root advance position pairs with close
ls, while the more retracted tongue-root position
ccurs with open vowels. In a companion article
tewart's, K. L. Pike (1967) elaborates on the
ure of tongue-root position in relation to
ious ways of describing pharyngeal openness. He
on to explore the articulatory implication of
ting separate status to the degree of tongue-root

advancement at least partially independent of that of the tongue blade. Further, in an independent study of West African languages, Ladefoged (1964) provides cineradiographic evidence clearly revealin that the more open Igbo vowels are effected by a re traction of the entire tongue mass which simultaneously constricts the pharyngeal cavity. On the other hand, these tracings portray the set of close vowels as a result of a more advanced tongue body position which creates an enlarged pharyngeal space

Interestingly, at the same time that Stewart and Pike were discussing West African vowel height and pharyngeal cavity correlations, Miller (1967) al published 'An acoustical study of Brou vowels', in *which a complex Mon-Khmer vocalic system* was descri ed. In that paper first-register vowels, described as 'tense, slightly faucalized' are said to be lower in tongue height during most of their duratio than corresponding second-register vowels, which have a 'deep, muffled, relaxed' quality.

A comparison of the spectographic first forman reading for Brou (Brũ) (Miller 1967:156-8) and Twi (Pike 1967:138) further reinforces the notion that some common underlying similarity exists. Since in Brou Miller recognized no register contras on either low or short vowels, they are not listed in the following chart. For the sake of simplicity the offglides are also omitted.

Twi Vowels

e Harmony Set		*Open Harmony Set*	
.75-200 cps)	u (200 cps)	ɩ (250-300 cps)	ʊ (300 cps)
.00 cps)	o (200-300 cps)	ɛ (400-500 cps)	ɔ (400-500 cps)

Brou Vowels

Second Register

i (400 cps)	ư (440)	u (400)
e (600)	∂ (520)	o (520)

First Register

ei (720-400)	∂ư (800-480)	ou (760-440)
ɛi (880-640)	aư (880-640)	ɔu (560-400)

Chart 3

While Brou vocalics in general are of a higher uency than Twi and exhibit extensive ongliding in first register, there is a clear parallel between l sets that at once exhibit features of contrast- openness coupled with differing degrees of yngeal volume. The Twi open harmony set and the t register Brou vowels have consistently higher uencies than their close harmony or second ster counterparts.

Consider as further examples the vowel array of ao, a North Bahnaric language of Vietnam, in arison with the harmony systems of the West can languages, Dagaari (Kennedy 1966) and (Grimes 1964:114).

Rengao

Second (Lax) Register			First (Tense) Registe		
i		u	${}^{e}i$		${}^{o}u$
e		o	ɛ		ɔ
	ə			a	

Dagaari

Close Harmony Set		Open Harmony Set		
i	u	ι		u
e	o	ɛ		ɔ
			a	

Kru

Bright	Muffled-Pharyngeal Resonant			Brig
i	i		u	u
e	e		o	o
ɛ		a		ɔ

Chart 4

I suggest that the parallelism between Mon-Khmer and West African language vocalic sets is mor than a superficial one. It is rather the result of an underlying articulatory complex common to both language groups. That this mechanical linkage between vocalic openness and pharyngeal volume has no been widely recognized among linguists until rather recently is hardly surprising. Linguists, concerne as they are with the code structure of language, of give insufficient attention to its signalling mechanisms. Unfortunately, too often this deprives the linguist of precisely the data he requires to solve the problems he considers central. More to the point in this case, however, is the fact that it is excessively difficult to determine with any sense

:ainty what is going on deep in the vocal tract. e we must seek help from experimental researchers .pped with instruments appropriate to the task.

Although study in the area of pharyngeal articu- ion is growing, its results are only beginning to realized. H. M. Truby (1967:540) complains, for nple, that even:

> ne very latest phonetics texts ... still portray ne pharyngeal volumes for all vowels the same-- demonstrable ignorance of fact, especially in ne face of considerable documentation to the ontrary in publication.[4]

A recent Cineradiographic study by Perkell 59) of the physiology of speech production graphi- ly reflects the co-functioning of tongue blade tongue body in English. His description (1969: , including his quoted observations of others, as follows:

> ne concavity in the pharyngeal region could be aused by the upward and forward pull of the ower fibers of the genioglossus and by the oward pull of the styloglossus. As MacNeilage nd Sholes (1964) write, "the posterior portion f the genioglossus muscle contracts to move the osterior surface toward the point of the jaw thus widening the pharynx) particularly for owels which exhibit a high tongue front position 'i/, /e/, /i/[sic], /oi/)". On the other hand, ne convexity could be caused by contraction of ne posterior fibers of the hyoglossus in con- unction with anterior fibers of the genioglossus o pull and "squeeze" the tongue body posteriorly. coustically, this concavity in the lower pharyn- eal region for high vowels causes an increase in olume in the posterior portion of the vocal ract, and thus contributes to a lowering of the irst formant frequency, which is the principal coustic characteristic of high vowels.

ances such as these in our understanding of speech siology should also enrich our approach to the analysis of phonological systems in many languages.

The phenomenon of systematic vocalic lowering has been of historical interest in Mon-Khmer studie from its beginnings. The explanation of this devel opment has usually involved reference to the nature of the original initial consonants. Consider, for example, the statement that:

> an original voiceless initial *generates* greater openness in timbre of the following vowel than does an original voiced initial (Coedès 1940-48: 67; emphasis mine).

Or again:

> The earlier *[gɔ.k] yielded modern [kɔ.k] /kɔk/, the earlier *[kɔ.k] yielded modern [ka.k] /kak/, the voiced initial of *[gɔ.k] not *affecting* the original openness, the voiceless initial of *[kɔ. *inducing* a lowering of the tongue to /a:/. Thus the register of the two nuclei, an intrinsic synchronic fact, is a reflex of the former nature of the initials (Jenner, 1966:143; emphasis mine)

In view of these explanatory statements, one is perhaps justified in wondering what the voicing status of a consonant has to do with tongue height particularly in what seems to be a causal sense. T be sure there is a connection between voicing of initials and vowel height, but is it in some sense causal? Apparently not. Rather descriptions of this type are presumably meant to be interpreted as saying no more than that forms with modern contrast ive vowel openness may be traced to historical pre- cursors in which there is no *written* vowel contrast (in the Indic script), but in which an initial con- sonant contrast of voicing is symbolized. Thus *initial consonants effect vowel changes only in* some metaphorical sense. In view of the earlier discussion of the mechanics of tongue-root articul

a, it is suggested that tongue height is best
lained in those terms. Moreover, as I will dis-
s below, consonant voicing also seems attributable
such activity. That is, tongue-root retraction
a lowers the vowel and creates conditions favor-
e for voicelessness, while tongue-root advancement
ults in a higher vowel and a set of voicing con-
ions.

Voice Quality (Resonance)

The most striking phonetic features in many
-Khmer languages are those involving cavity re-
ance. Indeed, these features have come to be
ctically equivalent to the term 'register'.
n referring to West African languages, it is
tructive to compare the 'choked' or 'strangled'
iculations of the Twi open vowels with the 'tight',
nstricted', 'pharyngealized (rasp)', 'faucalized'
lity of Mon-Khmer first register (open) vowels.
ther notice the terms 'hollow' applied by Stewart
Twi close vowels and 'deeper' and 'fuller' with
ch Pike (1967:130) had previously described sim-
r pharyngeal phenomena. These descriptions again
to be compared with Mon-Khmer second register
ose vowels) where the quality has been character-
d as 'sepulchral', 'deep', and having 'pharyngeal
onance'. It is further interesting that in Fante,
ther West African group related to Twi, there is the
relation of 'unraised' vowel with 'creaky' voice
lity and 'raised' vowel with 'breathy' voice
lity. Incidently, not unlike Henderson's approach
Cambodian register is Berry's analysis of Fante
els, in which differences in aperture are consider-
secondary to differences in voice quality
ewart 1967:169).

The articulatory basis for the auditory contrasts in West African languages has been identifie as tongue-root movement. Advanced tongue-root produces an enlarged pharyngeal cavity, creating impressions of resonance focused in that region, while tongue-root retraction constricts the pharyng cavity, producing a reduced resonance there. For Khmer Jenner (1966:34) also associates pharyngeal resonance with 'the act of distending the pharyngea chamber'. This expansion of the pharyngeal cavity is attributed by him (1966:32), however, to the low ing of the larynx and the widening of the faucal pillars. More tentatively, he suspects a third ges- ture, namely 'backing of the radix of the tongue to ward the pharyngeal wall', *may be involved in the* pharyngeally resonant vowels. Pike (1947:21) has described the production of such 'deep' pharyngeal resonant sounds in terms of all three of the above factors. *With reference to the action of the* tongu root, however, he prescribes an *advancement*, not a *retraction*, to achieve a distended pharynx. It was precisely this observation by Pike which sugges ed to Stewart (1967:197) the direction in which to seek the basis of Akan vowel set articulation.

Pike (1967:131) finds no lowering of the laryn in the Asante-Twi speech he observed. Rather the cavity *expansion seems to have been created solely* the forward thrust of the tongue body. On the othe hand, such lowering is true of Khmer, Jeh, and Rengao (see charts above). The West African materi suggests that larynx lowering is not *necessary* for the creation of an enlarged pharynx, tongue advancement being sufficient; however, Mon-Khmer material leads to the observation (as do Pike's original purely phonetic exercises) that there is atural basis for cooperation of speech organs in s region to expand *both* out and down resulting in aximized pharyngeal volume. They are apparently ependent, however. One may suggest that a marking ationship exists, such that with advanced tongue-t comes a natural expectation (but not require-t) of a co-occurrence of laryngeal lowering. n would be an 'unmarked' relationship. On the er hand, tongue-root retraction entails no such ectation; co-occurrence would be a 'marked' rela-nship.

Briefly summarized then, the auditory facts of -Khmer register contrasts seem quite naturally wed as based on the advancement or retraction of tongue-root. Advancement produces the deep ryngeal qualities of the Second (High) Register retraction produces the more constricted effects First (Low) Register. Laryngeal lowering is wed as a natural, but independent and optional rticulation with advanced tongue-root position. is also a satisfying conclusion that tongue height voice quality are both essentially correlative ects of the same articulatory gestures.

The above conclusions concerning the basis of ce quality stand in contrast with historical and chological explanations. For example, Pinnow s, 'The voiced stops have lost their voicing ... compensate for this shift, words of the Second ister are now pronounced in a deeper voice' oted in Jenner 1966:107). I hope to show below e 2.3) that resonance features such as 'deep ce' are not just arbitrary replacements for some vious different phonetic cue, but rather share h the consonants a common articulatory basis, namely tongue-root position.

It was a preoccupation with resonance features to the exclusion of their basis that obscured initi research on certain Mon-Khmer languages of Vietnam. Gradin (1966:41, 42) in his early work on Jeh described it as possessing 'deep vowel quality ... which parallels the laryngealization of Sedang and the breathiness of Halang...' Later studies (*cf.* Smith 1968:60) revealed that from a comparative point of view the parallelism was superficial. It was true that Halang breathiness and Jeh deep vowel corresponded, but not Sedang laryngealization. One does not have to look far for the basis of such faulty parallelisms. Jenner (1966:31), after summarizing register descriptions then available on several Mon-Khmer languages, is clearly correct in concluding that 'the common thread through these .. descriptions is articulatory action of a kind that sets up resonance of an "abnormal" kind which contrasts with "normal" oral resonance'.

One may now ask how helpful the opposition 'normal' vs. 'abnormal' is in understanding registe effects. In Khmer the First (Low Vowel) Register i 'normal', while the Second (High Vowel) Register is 'abnormal' (pharyngeally resonant). But it is the 'abnormal' register vowels that most closely reflec what seems to be symbolized in the writing system, while the 'normal' register vowels behave in a most 'erratic' fashion. Certainly terms 'normal' and 'abnormal', whatever virtues they may have simply a tags for *contrastive registers, give no insight int* the nature of the features (*e.g.* aperture, resonanc etc.) with which they correlate.

The parallelism first suggested for Jeh, Halang,
ang based on 'normal' vs. 'abnormal' auditory
ressions must, on both synchronic and historical-
parative grounds, be replaced by the array in
rt 5.

	Second (High Vowel) Register (tongue-root advanced)	First (Low Vowel) Register (tongue-root retracted)
	abnormal (deep, pharyngeal resonance)	normal (clear)
ang	abnormal (breathy, pharyngeal resonance)	normal (clear)
ang	normal (clear)	abnormal (laryngeal-ized, pharyngeal-ized rasp)

Chart 5

Note now that Jeh and Halang Second Register is
ryngeally resonant and thereby 'abnormal', while
ang Second Register is not pharyngeally prominent
any way and is by virtue of that fact 'normal'.
the other hand, the Jeh and Halang First Register
veys no exaggerated pharyngeal impressions and
be declared 'normal', whereas the Sedang First
ister has some sort of laryngeal and pharyngeal
lity and sounds 'abnormal'. From the point of
w of the normal : abnormal dichotomy this
ears to be a reversal--some kind of phonological
p. Actually, that is not the case. There is a
wing which we may diagram as Chart 6.

	Front tongue-root position (wide pharynx)	Central tongue-root position (medium pharynx)	Back tongue-root positio (narrow phar-ynx)
	Second Register advanced tongue-root	First Register (retracted tongue-root)	
Jeh	abnormal	normal	
Halang	abnormal	normal	
		Second Register (advanced tongue-root)	First Regist (retracted tongue-root)
Sedang		normal	abnormal

Chart 6

Phonologically, each of these three languages has a register opposition based on tongue-root position. Unfortunately, the pharyngeally expanded resonant p nunciation of Jeh and Halang as well as the pharyngeally contricted one of Sedang had both been lumpe together as 'abnormal'. They are abnormal, but for opposite reasons phonetically. That is, Jeh and Halang advanced tongue-root position is well advanc from a central tongue body posture, while its retra ed position is perhaps only slightly drawn back of that central position towards the pharynx wall. On the other hand, Sedang's advanced position is in th neighborhood of a central tongue-root position, whi its retracted position is well drawn back towards the pharynx wall. Thus there is no conflict betwee phonological and comparative facts among Jeh, Halan and Sedang. Jeh, Halang Second-Register forms with a well advanced tongue-root (abnormal) are cognate with Sedang Second-Register forms with slightly advanced tongue-root (normal) pronunciations.

ilarly, Jeh, Halang slightly retracted (normal) relate with Sedang well retracted (abnormal) ones. short, even though Jeh and Halang tongue-root range more fronted, while that of Sedang is more backed, opposition tongue-root advanced : tongue-root racted remains.

Consonant Voicing

The correlation in Mon-Khmer of voiced initial sonants with Second (High Vowel) Register and celess or glottally affected consonants with st (Low Vowel) Register is well-known (*cf*. Chart 1 Mnong in Chart 2). Historically the contrast is lected in the written contrasts in Cambodian and Indic based scripts. The same correlation is a chronic fact in Mnong, where the distinction ween voiced and voiceless initial consonants has n interpreted as rendering the other register tures (vowel height and voice quality) predictable hence subphonemic. This modern situation in ng seems to nearly portray the set of relationships t earlier existed in Mon and Khmer prior to the oicing of initial consonants.

The written initial consonants of Khmer and Mon, nalling as they do the same set of morpheme dis-ctions as are synchronically manifested by other ister features (voice quality, pitch, vowel aper-e), are generally taken as a phonological given, m which to derive modern register features. It not been considered meaningful to inquire why ced consonants correlate with Second (High Vowel) ister and voiceless consonants with First (Low el) Register. The study of the mechanics of gue-root articulation, however, leads to the gestion that the original voicing status of initials is more than an arbitrary starting point fo[r] subsequent phonological contrasts. Let us assume that, rather than several register features issuing from the one voiced : voiceless opposition in some sequential sense, all the features (voicing, pitch, vowel aperture, and voice quality) coexisted (as in modern Mnong), constituting a multi-feature prosodic opposition dichotomizing all syllables (or phonological words). It is suggested that all of these phonetic features are effects of an underlying opposition between tongue-root advancement vs. tongu[e-] root retraction. Voiced initials are an effect of advancement and voiceless initials of retraction of the tongue body.

The positioning of the tongue body has already been described as having a natural reciprocal effect on the position of the tongue blade (vowel height). It is hypothesized by Perkell (1969:57) that 'the intrinsic musculature has little function in vowel differentiation'. Rather vowels are produced by the action of the extrinsic musculature in positioning a semi-rigid tongue body in the speech tract. On the other hand Perkell (1969:65) says:

> Consonant production can be thought of as being accomplished by the action of both the extrinsic and intrinsic systems. As in the case of vowel production, the tongue body (or lips) must be positioned to enable a particular part of the tongue or lips to accomplish the specified articulation. For this reason, coarticulation effects of vowels are, for the most part, manifested by influencing the *position* of consonant-articulating organs rather than by altering the *manner* of articulation. Thus the positioning element of consonant production is performed by the slow extrinsic system and is strongly influenced by coarticulation effects. This positioning aspect presumably also operates to produce secondary features of consonant articulation such as palata-

ization, labialization, and pharyngealization.

s, as suggested by Öhman (Perkell 1969:65), 'the duction of a consonant can be thought of as being esture superimposed on the continuously varying el-producing system'. Looked at slightly ferently, vowels and consonants are dependent on ommon mechanism--tongue body positioning muscu- ure--as fundamental for their production. This precisely the parameter we have been investigating this paper, *i.e.* tongue-root advancement vs. gue-root retraction.

It is no novel observation that vowels and con- ants have similarities and mutually affect one ther. As noted above, point of articulation imilation is well-known between consonants and els. But the Mon-Khmer correlation involves cing as a coarticulation feature of vowel aperture, ce quality, and pitch. Can this be explained as ongue-root positioning effect? I think it can.

It has been pointed out (*e.g.* Perkell 1969:33-4; msky and Halle 1968:325) that the degree of ryngeal widening during consonant production ies depending on the particular consonant. In ticular, these references involve voiced 'lax' voiceless 'tense' consonants, where the former tematically exhibit a wider pharynx cavity than latter. Clearly, this accords with Mon-Khmer cing and pharyngeal correlations in each register. , to inquire further, what is there about an anced tongue body that it is compatible with cing or a retracted tongue body that it is patible with non-voicing?

The answer to our question perhaps involves the matter of air stream movement in speech production. *Chomsky and Halle (1968:326-7) explain:*

> In order for the vocal cords to vibrate, it is necessary that air flow through them. If the air flow is of sufficient magnitude, voicing will set in, provided that the vocal cords not be held as widely apart as they are in breathing or in whispering.

This is based on the fact that (Chomsky and Halle, 1968:300) 'the two major factors controlling vocal cord vibration are the difference in air pressure below and above the glottis and the configuration of the vocal cords themselves'. If there are no significant constrictions in the air passage, the lungs may freely drive air through the glottis, creating a vocal cord vibration. On the other hand, if there is a constriction in the vocal passage which resists the flow of air, the vocal cords return to a non-vibrating closed state since no air movement forces them apart for voicing. That is, a voiceless state exists. Since the air initiating mechanism continues to exert force, subglottal pressure does, however, continue to build until a threshhold is reached where the vocal cords are forced apart in a rapid expulsion of air. This correlation has been noted by Lisker (cited in Chomsky and Halle 1968:326, fn. 29), who says: 'The rate of pressure build-up is significantly slower for voiced stops than for voiceless.'

In view of these observations it seems possible to suggest that the advancement or retraction of the tongue-root can constitute a major air stream regulator. In a forward position the tongue body ideally raises vowel height, produces enlarged resonant rynx cavity, and permits the uninhibited flow of through the glottis for voicing of consonants. versely, in a retracted posture the tongue body ers tongue height, reduces pharyngeal resonance, restricts the flow of air, thereby producing a celess state for consonants. Specifically, the glottis with its mechanical linkage to the tongue hyoid bone may play a significant role in con- lling air movement (*cf.* Heffner 1960:19).

It has been noted that the registers in Mon- er are characterized as involving some kind of se vs. lax opposition (*cf.* charts 1 and 2). The relation of voiced consonants with the lax register the voiceless and imploded consonants with the se register accords with a general phonetic ob- vation that:

> ense phonemes are articulated with greater dis- inctness and pressure than the corresponding lax honemes. The muscular strain affects the tongue, he walls of the vocal tract and the glottis. The igher tension is associated with a greater eformation of the entire vocal tract from its eutral position (Jacobson, Fant, and Halle 1961: 8).

msky and Halle (1968:325) describe the possibility voicing to take place as a function of the tense- s of the vocal tract. Again this involves the ter of air stream pressure and movement through glottis. With a supraglottal constriction, ssure above and below the glottis rapidly equal- s and the vocal cords no longer vibrate with the sage of air through them if the vocal tract is idly constrained by strong muscular tension. On other hand, a generally lax vocal tract allows ansion as pressure builds and thereby permits a continuing vocal cord vibration, *i.e.* voicing. Certainly compatible with this interpretation of tenseness is the observation that in Mon-Khmer the 'tense' First Register, for which tongue-root retraction neatly explains vowel height and voice quality, manifests voiceless consonants, while the 'lax' second register, based on tongue-root advancement, manifests voiced ones. From this point of vie one may agree with Lisker and Abramson (1971:775) that pharyngeal enlargement need not merely be a 'passive response' to sub-glottal pressure, but is rather an 'active adjustment', *i.e.* tongue-root positioning.

In spite of the apparent applicability of tense ness vs. laxness to consonant voicing in Mon-Khmer, there are some infelicities, too. The problem is that in the 'lax' Second Register consonants are voiced, but vowels are high (close) and in the 'tens First Register consonants are voiceless (or imploded but vowels are low (open). When these lax register higher vowels are long, their production entails a certain visible flexing and bulging under the chin above the larynx. Stewart (1967:196ff) calls this 'chin lowering' for the tongue-root advanced vowels of Twi and feels that it fits Hockett's (1958:78-9) description of tenseness in European vowels. Hockett points to the 'bunching and tension in the muscles' under the chin above and in front of the glottis during the articulation of English *beat* versus the absence of such muscular action in *bit*. However, if West African tongue-root advanced ('raised') vowels are tense by this measure, one is *left with Stewart's (1967:196) hesitation about* tenseness in general:

On impressionistic grounds I have always felt un-
easy about applying the lax/tense terminology
to Twi or Fante as some of the unraised ('lax')
vowels, particularly the high ones I and U, have
often struck me as choked or even strangled.

e effect of this is that Stewart now has two types
tenseness--one that manifests itself in the
trangled', 'constricted' pronunciation of the open
nraised') vowels, and one that appears as the
cle bunching under the chin for the close ('raised')
vels. One is then faced with a choice of which
cular activity to focus on in applying the tense
lax terminology. In my opinion, Stewart makes
e right choice in taking yet a third alternative by
ndoning tense/lax as a distinctive feature and
ating the basis of his phonological opposition
rectly in the articulatory movements themselves,
. tongue-root position. In that case, tenseness
best applies redundantly and at worst is relegated
whatever other uses impressionistic terms can be
. In conclusion, then, I suggest that for Mon-
ner also the explanation of register phenomena such
voicing of consonants or positioning of vowels is
t founded on explicit references to specific
ech articulations (tongue-blade, tongue-root) and
ir movements (up : down, backward : forward) and
t other harder to define notions like tenseness,
as they often seem, be given secondary status.

The view that voicing is fundamentally associat-
with the management of pressures in the vocal
ct above and below the larynx has long been held
phoneticians (*cf.* Stetson 1951:37, 38, 50). It
essentially this assumption which is accepted by
msky and Halle (1968). However, more recently a
ber of investigators have argued that laryngeal

activity can be initiated independently by the intrinsic musculature of the larynx itself. This same line of reasoning, by the way, applies not only to voicing, but also to pitch. Lisker and Abramson (1971), representing something like an 'autonomous larynx viewpoint', for example, say:

> We assert the possibility, in the absence of evidence to the contrary, that the speaker exerts some control over the timing of voicing onset by determining the close down of the glottis. In absolute initial position ... it seems not unreasonable to suppose straight-forward control of the timing of contraction of certain of the laryngeal muscles.

The position taken by Lisker and Abramson appears to be a healthy reaction to a general view, in which laryngeal control is said to be basically outside the larynx itself. Now, however, the danger would seem to be a theoretical stance in which the larynx is held to function completely independently of other articulators. The authors cited do not as a matter of fact espouse the most extreme postion. Rather they are really doing no more than seriously questioning the 'dependent larynx' idea in view of the present incomplete state of knowledge on the topic.

While it is possible to assume that the larynx independently receives instructions from the brain *to initiate* vocal cord vibrations while the tongue base is advanced, and to cease such activity while the tongue is retracted in the Mon-Khmer register systems, it seems wiser, from a methodological point of view, to first ask whether there is a natural basis for a non-fortuitous cooperation between *tongue and larynx. That is,* considering the extent to which the muscular and neural systems of the gue and larynx are harnessed together, one would ect *interaction* rather than *independence* to racterize many of their relationships. Deeper erstanding of these connections will hopefully d light on the question of voicing in the context tongue-root articulations.

In addition to plain voiceless consonants, loded (glottalized) sounds are also usually Mon-er First Register correlates. Phonetically, im-sives belong to a class of ingressive suction ements. Typical of the production of clicks and losives is the role of tongue retraction in pro-ing a rarified outer cavity and a highly ssurized inner cavity. The backward movement the tongue cooperating with downward movement of vibrating glottis is specifically described for ma, an African language (Chomsky and Halle 8:323). The rapid and extensive laryngeal low-ng with ingressive air in the First-Register for losives is in contrast with the lesser laryngeal ering with egressive air that accompanies pharyn-l expansion in the Second-Register. The common ominator between other voiceless sounds and the loded ones seems to be that the period of onset articulation in which the larynx is lowered is a celess one. This is terminated by a rapid ttal release as the subglottal pressure is re-sed and voicing of the consonant begins.

As for the role of tongue posture during implo-e articulation, one may suggest that the vacuum ated in the pharynx by the descending larynx ates forces favorable to at least some degree retraction. Greenberg (1970) has noted that in eral the bilabial point of articulation is the most favored. Of course, this leaves the tongue fre to follow whatever other forces may be brought to be on it. Greenberg further notes that a retroflexed consonant is the next most common implosive. This clearly reflects tongue retraction and in some cases such retroflexion is considered more distinctive tha the implosion. Velar implosives, on the other hand, are apparently rare. Certainly this is true in Sout east Asian languages. But this would seem to be a major retracted articulation and thereby be expecte to appear frequently with implosion if, indeed, re-traction and implosion are naturally linked. If the tongue body retraction involved in implosives is act ing in concert with the forces created by laryngeal lowering, the tongue movement may be expected to be not only back but also *down*. Velar articulation, ho ever, requires a high arching of the tongue dorsum i contrast to the lower profile of dentals and labials In at least one set of English cineradiographic trac ings in Perkell (1969:58), the pharyngeal constric-tion was no greater for a voiceless velar than for a voiceless dental and even less than for a voiceless bilabial stop. Perhaps again, as in the case of vocalic effects of tongue-root movement, the most *natural tongue body path describes a 'slanting line* from high front in advanced position to low back in retracted position. This route would render the by-pass of velar implosives a not unexpected tendency.

2.4 *Pitch*

Pitch as a register feature is reported for Khmer as 'relatively high' in First Register and 'usually lower' in Second Register (Henderson 1952:51). Lower pitch in the Second Register as we as a rising pitch associated with final /-h/ is orted for Jeh (Gradin 1966). Level vs. falling es are reported to correlate with original surds sonants, respectively, in Riang (Luce 1965). tnamese, similarly, reflects a high set of tones ociated with voiceless initials and a low set ociated with voiced ones (Maspero 1912:102). For er and Jeh a classic register set exists, includ- pitch. For Riang, Vietnamese, and other Mon- er languages, the familiar vowel effects of ister are not reported, though the pitch-consonant tial correlation exists. Of course, the latter widespread in Asia outside Austroasiatic. In the e of Vietnamese, however, there are a number of mples of vowel correspondence with classic register guages in which the lowered First Register vowels e low reflexes in Vietnamese. This suggests that tnamese may once have had the fuller set of re- ter features, but lost all but tone. The same e of reasoning can be used to show that non-register guages of Vietnam once possessed register, which since disintegrated into a simple vowel contrast tem (in these cases minus pitch). Consider rt 7.

The sample comparisons in Chart 7 involve spe- ically the high front and back tongue-root racted register vowels, since they give the most matic evidence of 'downward migrations' in vocalic ce. There is enough lowering in Vietnamese to gest tentatively that such correspondences are ountable as former allophones of /i/ and /u/ in ginal tongue-root retracted register syllables. s has all been to say that Vietnamese, a 'tonal guage', gives some evidence of deriving its ginal pitch sets from the same articulatory

Register	*Non-Register*	*Tonal*	*Glosses for Example*
piq (OMon) *pi* (MMon) /pi/ [p^{e}i] (Rengao)	pe (Bahnar, Chrau)	ba (VN)	'three'
/bəli/ [bəl^{e}i]	pəle(Bahnar)	le (VN)	'bambo
mi (Mon), *me* (OKhmer) /miq/ [m^{e}iq] (Rengao) *cf.* kmie (Khasi)	meq (Bahnar)	mẹ (VN)	'mother
turow (OMon) tarau /tədru/ [tədr^{o}u] (Rengao)	*prăw (Proto-South Bahnaric)	sáu (VN)	'six'
appo' (OMon) lapa (MMon) /həpu/ [həp^{o}u] (Rengao)	(h)apo (Bahnar)	(chiêm-) bao mộng (VN)	'dream
pan (Mon); *pon* (OKhmer) /pun/ [p^{o}un] (Rengao) *cf.* Munda upun; Sak. humpun	*puən (Proto-South Bahnaric)	bốn (VN)	'four'

Chart 7

ditions that exist in the 'register languages'.

As mentioned earlier in connection with voicing, whole question of laryngeal control and pitch duction is a vexed one. Lieberman (1967) has ced considerable emphasis on the role of subglottal ssure as affecting fundamental frequency or pitch. efoged and Ohala (1970) and Fromkin and Ohala 68), on the other hand, while not denying the ects of subglottal pressure, rather attribute to it ore ancillary role. For example, Ladefoged and la (1970:25) say: 'at least 90% of the linguist- lly significant pitch patterns in English sen- ces are effected by means of controlled changes in laryngeal muscles.' Again, Fromkin and Ohala 68:103) say:

> ubglottal pressure could account for only about or 10 per cent of the observed F_0 change en- ountered on the stressed or accented words. This eads us to conclude that the laryngeal musculature lays a more important role on F_0 regulation in peech than does pressure.

Mon-Khmer languages which clearly exhibit the er register features more easily traceable to gue-root movement (vowel height and voice quality ecially), pitch is never a major feature. It is e often absent than present in register descrip- ns in various languages. This may be interpreted some kind of support for the view that laryngeal ivities are at least partially independent of gue movement. Yet when pitch does figure, it is her for First Register, lower for Second Register iculation. This leads to the assumption that re must be some natural basis for their co- stence. The question is not so much whether higher ch can be initiated by the laryngeal musculature alone in a given instance as it is whether some other set of conditions can *also* be a pitch raising or lowering factor. It is worth noting that Ladefoged and Ohala (1970:12-13) recognize not only subglottal pressure, vocal cord stiffness and mass, but also supraglottal impedance, as factors affecting the frequency of vocal cord vibration. They say, however, that

> When a subject alters his articulation, he alters not only the supraglottal impedance, but also, in some cases, the tension of the vocal cords. In saying vowels such as /i/ and /u/, and consonants, there are noticeable changes in the configuration of the laryngeal tissues which we must assume have a definite effect on the tension of the vocal cords.

This implies that an extreme tongue gesture can produce more glottal tension than a less extreme one and thus contributes toward greater vocal cord vibration. If in a given language /i/ and /u/ are produced with greater effort of the (extrinsic ?) musculature of the tongue than /a/ is, the former have a slightly higher pitch than the latter. This seems to be the case in a number of languages, including those of West Africa.[5] The interesting question there, however, is not whether /i/ and /u/ are higher in pitch than /a/, but whether the tongue root retracted allophone of /i/ is higher or lower in pitch than the tongue-root advanced allophone of the same phoneme. In Rengao, a Mon-Khmer language of Vietnam, the sharp low onset of First Register vowels by the retraction of the tongue is a distinct muscular action that is noticeably more vigorous than any Second Register gesture. On this basis First Register has been called 'tense' and Second Register 'lax'. In Rengao the First Register varia

Tongue-Root and Marking Relations

	Blade back	Blade low	Apex back	Larynx high	Glottis 'tense'	Height'd subglot. press.	Blade for-ward	Blade high	Apex for-ward	Larynx low	Glottis 'lax'	Lowere subglo press.
Root back	U	U	U	U	U	U	M	M	M	M	M	M
Root for-ward	M	M	M	M	M	M	U	U	U	U	U	U

Chart 8

of /i/, [^{e}i], exhibits greater muscular effort or tension than does the Second Register variant of /i [i]. Pitch differences are not noticeable to the u aided ear in Rengao, but if, as Ohala and Ladefoged seem to suggest, higher pitch may be triggered by articulator tension, then it is the tongue-root retracted First Register that should be affected. As we have noted, this is indeed the register so affec in other Mon-Khmer languages. The question of 'tenseness' is, however, as usual a slippery one to deal with systematically.

Regarding the relationship of tongue-root movement and laryngeal function (both voicing and pitch), it seems possible to say that a fundamental liaison exists between them such that it is natural though not inevitable, for certain cooperative activities to take place in speech production. At present, the exact mechanics of that relationship ar a matter of debate. Even so, certain possibilities that have been suggested in the literature lead one to the conviction that the tongue-larynx factors in Mon-Khmer register are not merely accidental correlates, but rather natural collaborators. I therefo suggest that certain features associated with regis phenomena (or comparable systems in other languages may be said to possess certain natural relations among themselves but are most notably *tied to tongu* root articulation. These marking relations are to be interpreted such that an unmarked (U) relationsh is expected, presumably because it has a natural physiological basis, while a marked (M) relationshi is less expected, for the same reason. Chart 8 expresses the set of associations I have in mind.

Vowel Harmony

In his description of Cambodian grammar, Huffman 7:58-62) says:

> many derivatives of disyllabic shape, the series the affix vowel is determined by the series of e base vowel. In a smaller number of forms, the ries of the base vowel is determined by the ries of the affix vowel. This kind of condi- oning is defined here as *vowel harmony*.

plifying the base vowel conditioned by an affix ites /muc/ 'to submerge' and /prɔmoc/ 'to put r'. An instance of the prefix vowel being itioned by that of the base is illustrated in the s /cək/ 'to bite' and /cɔcək/ 'to peck at' in t Register, as compared with /crul/ 'to exceed' /cocrul/ 'excessively' in Second Register. That /co-/ alternates with /cɔ-/, depending on the ster of the base vowel. Consonants are involved part of the 'conditioning' environment for affix l alternation. For example, /-ɔm-/ alternates /-um-/ as a caustive infix: /-um-/ occurs with s in which there is a Second Register vowel and second consonant of the base is a sonorant; /-ɔm-/ rs elsewhere.

In the Jadrap dialect of Rengao a general vowel ony also exists. In this case the presyllable etermined by the main syllable vowel and register. presyllable in general has the shape Cə-, where a non-contrastive vowel. While CəCVC is the l pronunciation for all words of both registers, e is a variant system in which CəCVC is appro- te for all Second Register words and those with t Register high vowels, but CaCVC or CɛCɛC, C, and CɔCɔC are found in words with First ster low vowels.

While vowel harmony has not been generally reported for Mon-Khmer languages, I wish to suggest t like the previously discussed features of register, this phenomenon too is a natural concommitant of a system which exploits tongue-root articulation. In the West African languages, it will be remembered, it is precisely a vowel harmony function that traditionally defines the set of tongue-root advanced vs. tongue-root retracted vowels. The question is, what connection does vowel harmony have with the movement of the tongue body?

To answer this question, let us return to the model of speech production referred to earlier in which consonant articulation is thought of as an activity superimposed upon the vowel producing system. Perkell (1969:61) says:

> ... the tongue is more active in consonant articu lation whereas the body of the tongue is active i articulating both consonants and vowels.

He goes on to add:

> The general differences in velocity, complexity, precision of movement, and in anatomy suggest that different types of muscles are generally responsible for consonant and vowel production. It is probable that articulation of vowels is accomplished principally by the larger, slower extrinsic tongue musculature which controls tong position. On the other hand, consonant articula requires the addition of the precise, more compl and faster function of the smaller intrinsic tongue musculature.

Let us add to this the observation attributed to Öhman (Perkell 1969:64) that the '(time) unit of natural speech encoding is more the size of a syllable than a phoneme'. Vowel harmony implies t the syllable is perhaps only a lower limit for spe timing.

In view of these observations on physiology and ng, we may diagram sample relationships of the ue body and the tongue blade through successive ges of state in speech production as Chart 9.

ue blade/ changes tate rinsic ulature)	1 C	2 C	3 C	4 V	5 C	6 C	7 C	8 V	9 C	10 C	11 V	12 C
ue body ges of e rinsic ulature)	1 ADVANCE						2 RETRACT					

Chart 9

ose 1, 2, 3, etc., represent temporal sequence change of state of the articulator named to the . Notice that the tongue body exhibits a lesser uency of change of state than does the tongue e or tip. While this over-simplifies the mech- ms involved, it does portray the idealized ation in which the basic body set moves relative- ittle (perhaps often phonemically non-contrast- y) while the upper part of the tongue moves ugh relatively more phonemically contrastive ts of articulation. In State 1 the tongue root orward as in Mon-Khmer Second Register. As this ure is maintained, a sequence of consonants and l adjustments are made by the tip and blade. his were Mon-Khmer we would expect to have the ial consonant voiceless or glottalized and the l relatively close. As the speaker produces the nd word, the tongue body retracts to State 2, e again it maintains its basic set through a es of more rapid gestures by the upper tongue.

This time, however, two of these *non-contiguous* bla gestures produce vowels. But since the tongue root state has been roughly the same throughout, these vowels share something that was not possible in State 1. Namely the blade reach for both of them has been restricted (lowered) in a way not true of the same blade gesture in State 1 with the tongue body forward. This means that all blade actions dominated by one root position describe a certain articulatory range, while those of another root position describe a different one. This is a natural basis for vowel harmony.

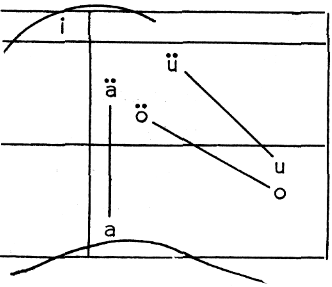
That the basis for vowel harmony is tongue-roo articulation in West African and Mon-Khmer language suggests that it may be a relevant factor in other languages as well. For example, descriptions of Mongolian vowel harmony in the literature yield certain parallels. In Mongolian the harmonizing feature is tongue advancement with reference to bot consonants and vowels. Lightner (1965:244-50) has advocated the use of a word-root marker GRAVE to yield a prosodic specification in the base forms. Stuart and Haltod (1957:87) earlier had said:

> were there no exceptions we might describe Mongolian with only four vowels, *i.e.* /a, o, u, i/, plus two opposed characteristics (front:back) appertaining *not to the phoneme segment but to the word*. The rules of vowel harmony hold sufficiently well, as it is, for words violating these rules to be definitely conspicuous. [Emphasis mine.]

They go on to note that native grammarians call th back group 'masculine' and the front 'feminine'. one follows their suggestion and posits these basi vowels, how are the parameters to be labeled? Pre sumably something like the following:

	Front	Back
High	i	u
Low	a	o

then what does the suggestion about multiplying whole set by another front-back *word factor* n? Apparently, for example, the high front unit ust have a further sense in which it is 'front' 'back', the high back u must again be further cified as to 'front' or 'back'. An examination the supposed tongue positions (Stuart and Haltod 7:83) will perhaps be helpful [lines connecting el counterparts are mine]:



Minimum tongue aperture

Maximum tongue aperture

interesting fact is that what are the *back set* vowels are equally and perhaps more significantly) a *lower set* of vowels. Note that historically re was apparently an earlier pair of i vowels, they are not now distinguished. The allophonic ering of i before ng (Stuart and Haltod 1957:81) however, probably significant, being a tongue raction environment. In view of the general vowel ering connected with tongue-root retraction noted ewhere, a similar interpretation seems inviting Mongolian. Thus an underlying *tongue blade* nt-*back* contrast would be distinguished from a gue *root front-back* distinction and could be shown schematically as:

	tongue-root front		tongue-root bac	
tongue blade	front	back	front	bac
blade high	i	ü	i	u
blade low	ä	ö	a	o

The flatness (roundedness) feature, then, rather tha being a major feature as in Lightner (1965) would b predicted by the very natural general rule that bla front vowels are unrounded (-flat) and blade-back vowels are rounded (+flat).

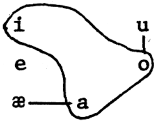
Another example of vowel harmony is found in Nez Perce. Zwicky (1970:116) arrays the vowels as:

The vowels I have connected by lines are harmo counterparts, the lower or backed ones forming a class called *dominant* and the upper or fronted ones a class called *recessive*.

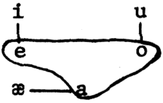
> If a word contains a dominant morpheme (one with dominant vowels), all vowels in the word are dominant. Some morphemes with the vowel i are dominant, some recessive. (Zwicky 1970:116.)

Note, not unlike Mongolian above, *i* does not take a phonetically distinct counterpart.[6] This fact becomes important in the analysis of Zwicky and others in attempting to propose a natural underlyin system in which *i* has both *dominant* and *recessive*

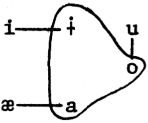
.ants that are plausible. The features which are
.oyed to define the system are *high, low, back,*
round. Some of the main underlying systems
ered are these:



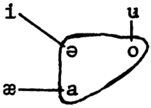
Rigsby-Silverstein system



Rigsby-Silverstein revised system



Rigsby-Silverstein variant



Jacobsen system

Chomsky and Halle (1968:372) declare that /i, a,
and /i, æ, u/ are 'not natural classes in any
sonable phonetic framework' and their categoriza-
ı should not be based on phonetic features. They
›ose an ad hoc diacritic feature /H/ to distinguish
two sets. If, however, one posits an underlying
gue-root position contrast as the basis for vowel
ıony in Nez Perce, as it appears to be in the
er languages described above, one must conclude
: the sets rejected by Chomsky and Halle are very
ıral classes and that it is the phonetic framework
: is not 'reasonable.' If, as in Mongolian, there
ı lost historical alternation even for /i/, the
sses become even more convincing. It appears
: the palatalizing effect of some /i/'s on conso-
:s (Zwicky 1970:124-5) does reflect such an
.ier state of affairs.[7] The logic of tongue-root
.culation would, then, seem to indicate that any

of the three alternatives for underlying systems above except the first Rigsby-Silverstein system would be plausible. Zwicky prefers Jacobsen's system, but if we abondon the attempt to describe th vowel pairs only in terms of blade position (high, low, back) and turn to tongue-root factors, it does not matter much whether the retracted variant of /i *was /e/, /ə/ or /ɨ/--all are tongue retracted in* opposition to the other tongue root advanced varian The analysis of vowel harmony systems in a number of other languages may also become less complicated if the tongue-root dimension is incorporated.

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[1]The observations of this paper were first written in a working paper done at a Summer Institu of Linguistics workshop at Nhatrang, Vietnam, in 1969. The current version expands and updates that study somewhat. I have especially profited from discussion with Richard Pittman, Kenneth Smith, and David Thomas.

[2]Jenner (1966:37, fn. 52) has noted that the task of defining register may be approached from either the point of view of the mechanics of production or that of their perceptible effects. He says that for reasons of economy he has chosen the latter; the present study focuses on the former.

[3]Chomsky and Halle (1968:314-15) suggest the features 'covered-noncovered' to describe the West African vowel harmony characteristics. They consid it basically a vowel related phenomenon and mainly a West African phenomenon. I suggest that this opposition is much more far-reaching than either of those observations suggest. The terms 'covered-noncovered' also seem more nebulous than necessary. Tongue-root advancement: Tongue-root retraction is more enlightening.

[4]This indictment is not universally valid, of course, for such works as Heffner (1960) and Jakobson, Fant and Halle (1961), to mention just two, explicitly correlate pharyngeal and oral features. It does, nevertheless, reflect the fact

t the topic has not received the attention it
its in view of its relevance for phonology.

[5]In contrast to this, note that in Tlingit it
reported (personal communication from Constance
sh) that the vowels /i, e, a, u/ have high or low
e, but that /ɪ, ɛ, ʌ, ʊ/ have only high tone. In
s case, except for the ʌ vowel, it is the lower
els that as a class favor higher pitch.

[6]In Finnish it is reported (Jakobson, Fant, and
le 1961:41) that again the front vowels /e, i/ do
take part in the vowel harmony process.

[7]Note that historical palatalization phenomena
West African languages also coincide naturally
n tongue-root advanced vowels.

REFERENCES

Blagden, Charles Otto. 1910. *Quelques notions sur la phonétique du Talain et son évolution historique.* *JA* (10e Ser.) 15.477-503.

Chomsky, Noam, and Morris Halle. 1968. *The sound pattern of English.* New York: Harper and Row.

Coedès, George. 1940-48. Les langues de l'Indochin *Conférences de l'Institut de Linguistique de l'Université de Paris* 8.63-81.

Cooper, James and Nancy. 1965. Halang phonemes. *Mon-Khmer studies II*, 57-72. Saigon: Linguistic Circle of Saigon and the Summer Institute of Linguistics.

Fromkin, Victoria A., and John Ohala. 1968. Laryngeal control and a model of speech production. *Working Papers in Phonetics* No. 10, University of California, Los Angeles.

Gradin, Dwight. 1966. Consonantal tone in Jeh phonemics. *Mon-Khmer studies II*, 41-53. Saigon: Linguistic Circle of Saigon and the Summer Institute of Linguistics.

Greenberg, Joseph H. 1970. Some generalizations concerning glottalic consonants, especially implosives. *IJAL* 36.123-45.

Grimes, Joseph. 1964. Several Kru orthographies. *Orthography studies*, ed. by Smalley, 114-19. London: United Bible Societies.

Halliday, Robert. 1922. *A Mon-English dictionary.* Bangkok: Siam Society.

Haswell, James M. 1901. *Grammatical notes and vocabulary of the Peguan language.* Rangoon: American Baptist Mission Press.

Heffner, R-M. S. 1960. *General phonetics.* Madiso University of Wisconsin Press.

Henderson, Eugénie J.A. 1952. The main features o Cambodian pronunciation. *BSOAS* 14:1.149-74.

Hockett, Charles F. 1958. *A course in modern linguistics.* New York: Macmillan.

Huffman, Franklin E. 1967. *An outline of Cambodia grammar.* Ph.D. dissertation, Cornell University

Jacob, Judith M. 1968. *An introduction to Cambodian.* London: Oxford University Press.

obson, Roman, C. Gunnar Fant, and Morris Halle. 1961. *Preliminaries to speech analysis.* (4th ed.) Cambridge: MIT Press.

ner, Philip. 1966. *Khmer phonemes and syllables.* Honolulu: University of Hawaii. (Mimeo.)

nedy, Jack. 1966. *The phonology of Dagaari.* Insitute of African Studies, University of Ghana.

efoged, Peter. 1964. *A phonetic study of West African languages.* Cambridge: Cambridge University Press.

oerman, Philip. 1967. *Intonation, perception, and language.* (Research monograph 38.) Cambridge: MIT Press.

ntner, Theodore. 1965. On the description of vowel and consonant harmony. *Word* 21.244-50.

ker, Leigh, and Arthur S. Abramson. 1971. Distinctive features and laryngeal control. *Language* 47.767-85.

e, G.H. 1965. Danaw, a dying Austroasiatic language. *Lingua* 14.98-129.

Neilage, P., and G. Sholes. 1964. An electromyographic study of the tongue during vowel production. *Journal of Speech and Hearing Research* 7.209-32. (Cited in Perkell 1969.)

pero, Georges. 1915. *Grammaire de la langue khmère (cambodgien).* Paris: Imprimerie Nationale.

pero, Henri. 1912. Etudes sur la phonétique historique de la langue annamite: les initiales. *BEFEO* 12.1-126.

ler, J.D. 1967. An acoustical study of Brou vowels. *Phonetica* 17.149-77.

s, Richard B. 1966. The treatment of */r/ in two modern Khmer dialects. *Studies in comparative Austroasiatic linguistics*, ed. by N. Zide, 89-95. The Hague: Mouton.

la, John, and Peter Ladefoged. 1970. Further investigation of pitch regulation in speech. *Working Papers in Phonetics* 14.12-24.

kell, Joseph S. 1969. *Physiology of speech production.* (Research Monograph 53.) Cambridge: MIT Press.

llips, Richard. 1962. Voice register in Mon-Khmer languages. Unpublished ms.

Pike, K. L. 1967. Tongue-root position in practica phonetics. *Phonetica* 17.129-40.

Shorto, H. L. 1966. Mon vowel systems: a problem in phonological statement. *In memory of J.R. Firth*, ed. by Bazell, Catford, Halliday and Robi 398-409.

Smith, Kenneth D. 1968. Laryngealization and de-laryngealization in Sedang phonemics. *Linguisti* 38.52-69.

__________. 1972. *A phonological reconstruction of Proto-North Bahnaric*. (Language Data, Asian-Pacific Series 2.) Santa Ana: Summer Institute of Linguistics.

Stetson, R.H. 1951. *Motor phonetics*. (2d ed.) Amst dam: North Holland Publishing Company.

Stewart, J. M. 1967. Tongue-root position in Akan vowel harmony. *Phonetica* 16.185-204.

Stuart, D. G., and M. M. Haltod. 1957. The phonol of the word in modern standard Mongolian. *Word* 13.65-99.

Zwicky, Arnold M. 1970. More on Nez Perce: on alternative analyses. (Working Papers in Lingui tics 4.) Computer and Information Science Research Center. Columbus: Ohio State Universi